Capstone 2 - Final Project Report
Florida Polytechnic University
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Project Title: Lakeland Regional Hospital Real-Time OR Dashboard for Turnaround Times

Team Name: Lakeland Regional Health OR Dashboard

Course: COP4935

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1. Introduction

"Turnaround Time" or TAT is a term commonly used in businesses and is the time it takes to complete a process from start to finish. Within the context of healthcare, specifically the Operating Room (OR), TAT is the time between the end of one surgery and the start of another within the same room. During TAT, the turnaround team is responsible for cleaning the area, sanitizing materials, and selecting/preparing the appropriate equipment for the next scheduled surgery.

The sponsor for this project, Lakeland Regional Health (LRH) has goals for several metrics across their departments. The most important of these for our purposes is the OR Turnaround Times goal. This goal is for 80% of their surgeries to meet a TAT of 30 minutes or less. To assist in further optimizing their process and help meet their goals, LRH's OR department has requested a Tableau dashboard. This tool uses real-time data tracking to give better insight into the progress for turnaround per room as well as important information describing the patients and operations.. Additionally, the dashboard will display summary metrics which can be filtered to certain windows of time. This function will allow users to identify bottlenecks and other issues within the process. LRH plans to use the summary/analytics tab to present to stakeholders and other product users. These include both surgeons and nurses, as well as those part of the clean-up staff known as the Environmental Service Technicians (EVS).

2. Customer Needs, Objectives, and Constraints

2.1 Customer Needs

Our customer needs are directed at Lakeland Regional Health, focusing on their employees. The primary individuals using the dashboard functionalities will be the Operating Room employees. They will use this to help with managing their daily tasks, whilst optimizing procedures over others when needed. Requirements that must be met include:

- Dashboard utilization through Tableau
- Dashboard "views" which include interactive visualizations of:
    - Entire Operating Room Floor Plan with Every OR Location
    - Individual Room Metrics
    - Summary Statistics
- A real-time data transfer operation with scanning incorporation.
- Tableau design elements must include:
    - State of Each Operating Room (expressed through color distinctions, icons, etc.)
    - Elapsed Time Per Services
    - Patient Visibility
    - Staff Alerts

2.2 Design Objectives

The dashboard must be created through Tableau and work with already included functionalities. Information displayed must be easy to understand and provide relevant information reflective of current operations. This also requires us to incorporate a data-transfer system that is able to transfer trackable information, as Tableau does not have anything pre-built within its current application. The data-transfer system must also include a scanning function that can be utilized as individuals travel/interact with different operating rooms.

2.3 Functional & Non-functional Requirements

For functional requirements, scanning must be able to occur on patients/staff that travel to and from each operating room. The information through the scans must then be able to be transferred within a hosted server, which then needs to be directly parsed within Tableau. Information transferred must reflect current operations, which needs to display upcoming information on both patients and operations to assist with continued preparations. Each scan must include a timer that starts at every procedure change. This timer must help the operating room staff keep track of the current turnaround progress. The Operating Room floor plan must visually track patients and staff. Data analytics within all rooms must also need to be utilized daily by Lakeland Regional Health decision-makers both visually and informatively.

For non-functional requirements, we are limited by what we are allowed to use to accomplish what our sponsors require of us. Tableau does not currently have real-time capabilities in tracking information. We are required to create our own method of doing this. Through this proof-of-concept, our focus is not on security functionalities. With this implementation of a data-transfer operation, we must look towards how the hospital is able to do so through their Cerner system that helps provide health records electronically (EHR) when we are implementing our operation. The sponsor staff incharge of us also requires that we keep their color scheme when designing the visuals for the dashboard. This requirement is reflective on currently existing platforms rather than for the dashboard to become the “brand standard”.

2.4 Constraints

For our constraints, we are not allowed by the hospital to use actual data. This is due to the sensitivity of patient data that the hospital is weary of letting us use any form of this for the project. The staff incharge of us also do not have direct access to that data as well. So on top of having a hard time communicating with their IT team on trying to possibly use actual data, their hesitancy has set our focus on providing only dummy data. We also are limited by what we are allowed to use to accomplish what our sponsors require of us. Tableau does not currently have real-time capabilities in tracking information. We are required to create our own method of doing this. Through this proof-of-concept, our focus is not on security functionalities. With this implementation of a data-transfer operation, we must look towards how the hospital is able to do so through their Cerner system that helps provide health records electronically (EHR). With this as well, the requirement of us on looking towards Cerner is purposeful as we are required to focus on replicating what the hospital does.

3. Concept Generation and Alternatives Analysis

3.1 Literature and Product Review

For this project, all literature/product review was centered on other turnaround tools used in similar industries as well as traditional Operating Room dashboards. We consider related industries to be any other business that runs on a 24-hour cycle. This includes transportation such as airlines or trains, logistics services and airports themselves. We primarily focused on the airline industry as they had the most literature related to our purposes. From these sources the team was able to get a better idea as to what features the OR could benefit the most from. Looking at other OR dashboards gave the team guidance on the aesthetics of the dashboard as well as what data is most important. In dashboard design there is a rule where the placement of objects or graphs indicates its importance. For example, placing a figure on the top left emphasizes that data while the bottom right de-emphasizes it. We used both the examples from other OR dashboards as well as this rule in designing our final iteration.

3.2 Concept Generation

With our project, we originally were tasked with just focusing on creating our own dashboard tool that can reflect whatever data we put in it. However, our sponsors have expressed to us that the dashboard must be created through Tableau. This is due to Lakeland Regional Health already implementing this throughout its entire facility that all staff are familiar with and utilize currently. Afterwards, we then discussed with the hospital's IT team about how they are able to utilize data within Tableau. They ultimately led us to look into Cerner, which the hospital currently uses. Specifically, it focused on having a FHIR interface that can take scanned information sent through a server directly to Tableau that the hospital staff can utilize and decide whether they need to store that information in their database or not. Below is a visual aid of this process brainstormed to take place, as well as a server we tested running with updated information that can is being inserted into a Tableau to show this real-time data visually:

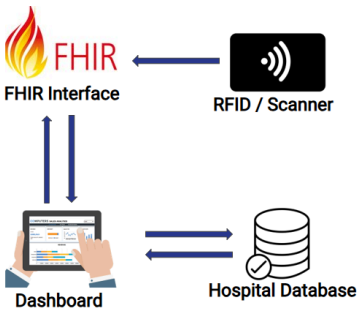


Figure 1. Cerner process incorporated to Tableau

```
 * Running on all addresses (0.0.0.0)
 * Running on http://127.0.0.1:5000
 * Running on http://10.221.85.74:5000
Press CTRL+C to quit
10.221.81.68 - - [13/Apr/2025 16:48:06] "GET /metrics HTTP/1.1" 200 -
10.221.81.68 - - [13/Apr/2025 16:48:11] "GET /metrics HTTP/1.1" 200 -
room 1111 +1
🛠 Updated Room 1111 → staff_cnt: 6
> 10.221.81.68 - - [13/Apr/2025 16:50:39] "GET /metrics HTTP/1.1" 200 -
set 2 patient_frst Sarah
🛠 Updated ID 2 → patient_frst = Sarah
> set 3 turnaround_status Over
🛠 Updated ID 3 → turnaround_status = Over
> 10.221.81.68 - - [13/Apr/2025 16:51:17] "GET /metrics HTTP/1.1" 200 -
```

Figure 2. Server example showing data updates

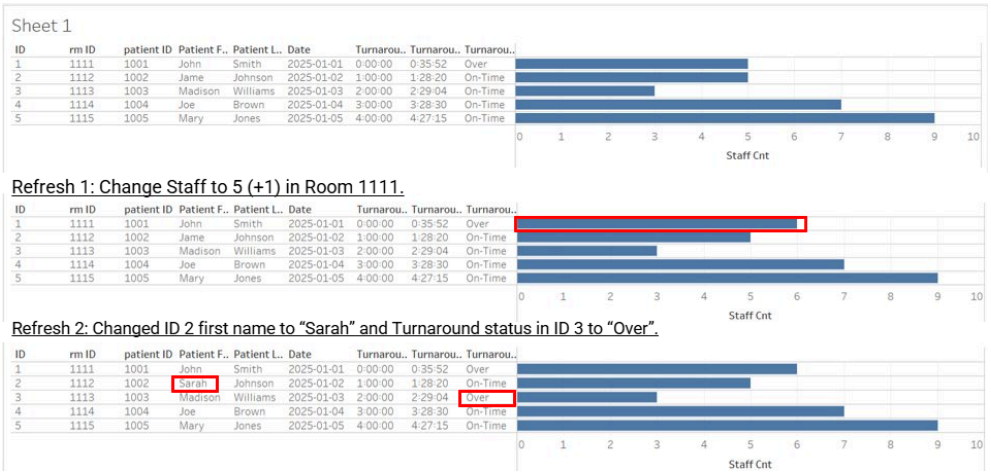

Sheet 1
Refresh 1: Change Staff to 5 (+1) in Room 1111.
Refresh 2: Changed ID 2 first name to "Sarah" and Turnaround status in ID 3 to "Over".
Staff Cnt

Figure 3. Tableau displaying updates from server changes expressed in figure 2

3.3 Evaluation and Selection

Ultimately, the selection of the plan we needed to work on ultimately the final point told in section 3.2. Specifically with Tableau, we emphasized wanting to switch to another dashboard tool (such as Grafana or Inetsoft), as tools like these already have real-time capabilities developed within themselves. Either choice between Tableau or others would be easy to understand. Tableau currently does not have any way of doing real-time data without us implementing it through a FHIR interface. The hospital required us to use Tableau. The tradeoff here of using a familiar tool by the staff that could be implemented in the hospital, is the fact that we have to create a real-time data transfer system through Cerner's FHIR interface. Below is a weighted decision matrix with options including:

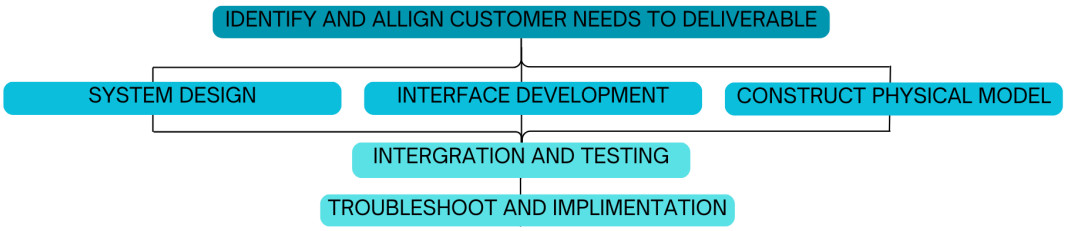
- Staff are currently familiar with the tool.
- Real-time data can already be collected.
- Tool is easy to understand.
- Currently implemented within the hospital.

Criteria	Weight	Staff Familiar?	Real-Time Data?	Understand?	Implemented?
Other Tools	1	0	1	1	0
Tableau	1	1	0	1	1

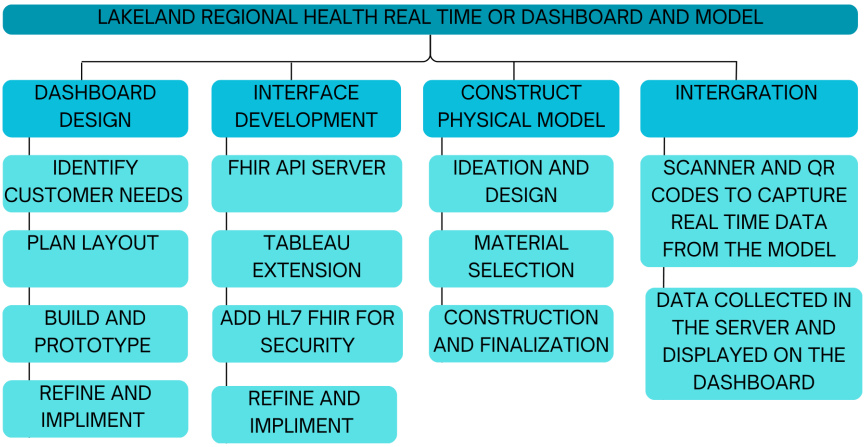
Figure 4. Weighted decision matrix chart with results below comparing Tableau to other dashboard tools

Grades
Other Tools = 2
Tableau = 3
Winner = Tableau with 3 vs 2

3.4 Flowchart of Design Process



3.5 Functional Decomposition



4. Applicable Codes and Standards

There are multiple applicable codes and standards that are applicable when working with healthcare and technological industries and practices. Three that stood out for our purposes of building a dashboard for the OR include HIPAA (Health Insurance Portability and Accountability Act), HITECH (Health Information Technology for Economic and Clinical Health Act), and HL7 FHIR (Health Level Seven Fast Healthcare Interoperability Resources). HIPAA is essential to ensure the protection of patient information. HITECH is an extension of HIPAA with a greater focus on

promoting security and disclosing any breaches in IT. While we did use a dummy data set, these Acts would be critical for implementation at LRH. The HL7 FHIR standards were incorporated directly into our dashboard creation with a primary focus on ensuring interoperability while maintaining data protection.

5. Prototyping and Design Details

5.1 Proof of Concepts

Our physical model served as a proof of concept, showing how clinical staff can input data and have it displayed on our dashboard in real time. The QR codes located on the entry and exit ways of the doorframe show any means to input data. For demonstration purposes, we used a scanner and a QR code. This is a proof of concept of nurses scanning their badges when entering and exiting the room, or when a patient's hospital band with an additional barcode can be scanned for the same purpose. An additional proof of concept shown by this is the implementation of an RTLS sensor located in the doorframe where the QR codes are located. The patients and staff would then wear an RFID tag in place of the QR code located on the figure to capture real-time data without any touchpoints, only automatic upload as an individual passes through the doorframe.

5.2 Design Implementation

To implement a way to display our proof of concept via the model, we created a layout consisting of 2 operating rooms, 1 patient holding area, and 1 clinical office space. We then printed 3D figures to represent clinical staff and patients. Two sets of QR codes were generated, the first represented mock patients that we created (John and Sarah), and the second set of QR codes were placed on entry and exit ways of the dashboard to represent a means of data input.

5.3 Alpha/Beta Prototype

In the fall semester, a non-functional mockup was created to propose a general idea to the sponsors of what the team envisioned the final product looking like. This would serve as an overall roadmap for the team as we went into the development portion of the project.

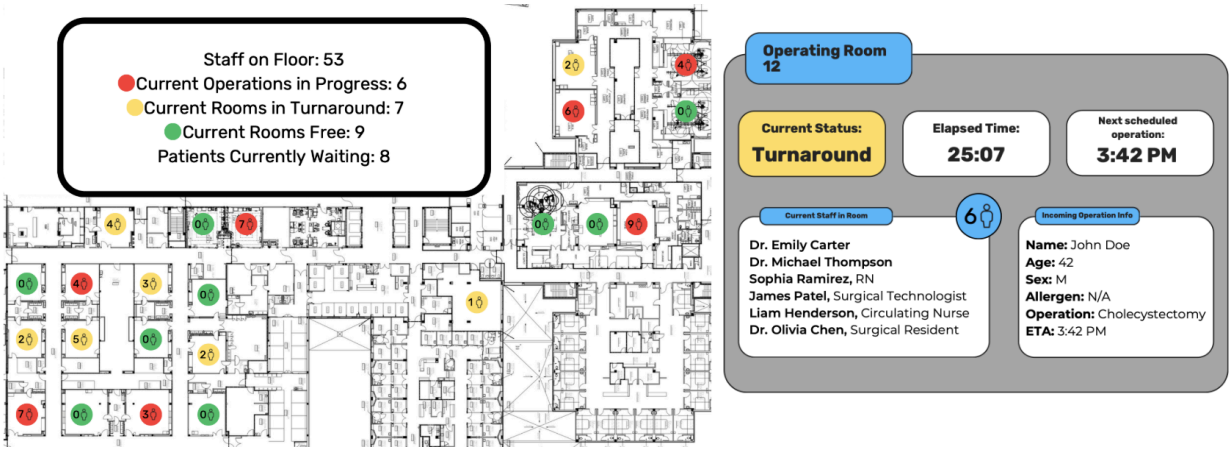


Figure 5. Non-functional dashboard mockup

Moving forward to the beta stage of the project. The bottom left corner of the mockup dashboard was cropped out to be the beta OR floor for dashboard development. This corner allowed us to implement, test, and edit anything from buttons to individual room views - as well add the connection to the real time data. After adding all the features and fixing any problems or bugs that the dashboard had, the beta version could then be blown up to the full scale of the map to help reach the final version that would be delivered to the hospital.

Figure 6. Beta version of the dashboard

6. Testing and Evaluation

6.1 Testing Methods

For this project, the team did not have access to hospital data, as it is privileged information. Instead, the team opted to use a dummy database, also known as a test database, that would simulate the real data. Testing for the product included using a method known as “component testing”. Using this methodology, each major component, the interface and dashboard, were tested using the dummy database/dataset (converted to .csv/.json). The primary goal was to see whether each component could take the data, perform the necessary transformations, and display the appropriate output in real-time.

6.2 Results Summary

The tests were very effective at demonstrating the products functionality. For the interface, the tool was able to take input and upload straight to the dashboard via a .json file. The interface is programmed to update/push the data every 5 seconds so it could keep up with any edits made at a “real-time” pace. For the dashboard, it was able to connect with the interface and display all changes once refreshed. The dashboard itself does not function in real-time on our side, but the hospital has

the required license to operate in “Tableau Server”. With Tableau Server, LRH can enable auto-updates. So the dashboard technically meets the real-time criteria as well.

7. Risk Assessment and Mitigation

When dealing with these types of healthcare technologies there are certain risks involved and consideration that need to be made. This dashboard would populate with all hospital derived data which would be stored in a hospital database or data warehouse. Security precautions are already implemented at Lakeland Regional Health and there are certain guidelines when handling this type of data. The real time data transfer interface would need to be analyzed, exploited, and secured by cybersecurity professionals to ensure that it is secure against any potential data breaches or cyber attacks. An additional risk brought up throughout this semester is the “what if?” of the potential of turnaround crews rushing or doing a sloppy job due to the implementation of a turnaround timer into the dashboard. Currently there are slim to none issues when dealing with the overall quality of the turned-around rooms, and it is to be believed that with the following controls in place the likelihood of quality decline would be low. The goal of this dashboard is not to be necessarily implemented inside of the OR as turnaround is being done, nor is the goal to have a live timer be displayed counting down or up to the 30 minute turnaround goal. Because the dashboard and the timer is not being displayed directly for turnaround teams to see, the extra stress or pressure of trying to meet a 30 minute turnaround would not be any different to that currently being experienced. Random or average quality audits can also be performed to confirm and/or address any potential slack incurred after the implementation of the dashboard.

8. Conclusions and Future Work

8.1 Summary

We were able to deliver a dashboard to Lakeland Regional Health that displays a multitude of information to enhance visibility for their OR department. Some of the information that is displayed includes the turnaround status of all rooms on the OR through metrics and a floor plan view, summary statistics of both room-specific and patient information, and staff count.

The dashboard pulls information straight from the server, which updates its information every 5 seconds automatically, but a manual refresh is needed for the information to be seen in the dashboard itself due to the limitations of the version of Tableau that we are working with.

We created a physical model to visually demonstrate our proof of concept of ways to input real-time data from patients and clinical staff, as this was one of our most important customer needs. QR codes outside of the doorframes represent a means to input data, whether this be a scanner (which we modeled in our demo) or an RTLS sensor installed in the doorframe for touchless real-time data collection. Once the data was scanned and obtained from our figures, moving from the patient holding to the operating room, the server was able to display the information in our dashboard. We had multiple screens displaying the OR layout of all of the rooms’ turnaround status, in-room summary statistics of patient information, and turnaround metrics based on their 30-minute goal.

8.2 Lessons Learned

We learned a few things such as:

Through the course of this project, we looked towards Tableau's capabilities in handling real-time data. As it does struggle to incorporate proper use of this information when displaying through dashboards that can be made, tools outside of its already established functionalities (including server/client hosting) were able to accomplish this for us. It is recognized as well that other dashboard tools are already capable of working with real-time information (such as Inetsoft and Grafana) on their own without other resources. Unable to fully utilize the services provided by the hospital, we were able to identify and flesh out the process that goes into the TAT logistics of the hospital. To this, this understanding has provided a perspective on time constraints within the hospital and how they impact the facility that has helped us in gaging what Tableau needs to show..

With this project as well, we have understood the costs that would be required for us to fully achieve what the hospital would fully want. On top of requirements towards developing full RFID technology, software incorporation (such as fully-licensed Tableau and Cerner capabilities) have impacted our decisions. The developmental standards we have chosen are cost-efficient, limiting higher quality but covering the capabilities the hospital wanted us to strive for that they did not have.

8.3 Future Development

This end result of the academic years capstone project lays a good foundation for this project to potentially continue development as there are additional measures that need to be added. The dashboard is completed but multiple things need to be changed to ensure a project of this scale is ready for deployment. With this tool being used in healthcare, security is a must. Currently no extensive cybersecurity measures are in place, thus making the data used a risk for cyberattacks. We recommend a cybersecurity professional to pen test and buff up the security features on the backend FHIR interface, and ensure that all data in the dashboard are confidential and only visible on a need-to-know basis. Currently the data is updated on our backend automatically, but must be manually clicked in Tableau to refresh the data that populates the dashboard. Our sponsors stressed the importance of real time data, and the manual aspect can be a potential bottleneck for efficiency as someone would need to consistently refresh the dashboard. If this were to be implemented a third party plugin, Tableau Server, or Tableau Cloud should be utilized to eliminate the need for a manual refresh, these tools have the potential capabilities to give real time data with minimal downtime - something needed by LRH. This project has made tremendous progress since conception and has the potential to be further continued as a capstone project by Florida Poly students or by the professionals by LRH.

9. Individual Contributions

Team Member	Contribution	Percentage
Joshua Kennedy	Dashboard deliverable, Showcase demo	18%
Amanda Rodriguez	Dashboard deliverable, Showcase demo	19%
Renato Silva e Silva	Physical Model	7%
Majella Scheyhing	Physical Model, Demo Implementation	18%
Kenneth Pierce	Realtime data interface / server	19%
Kaleb Walden	Realtime data interface / server	19%

10. Appendices

Appendix 1: Customer Needs and Requirements

Customer Needs -

- Elapsed Time Tracking (real-time data flow)
- Live Status Updates
- Improved workflow coordination
- Patient tracking
- KPI tracking/analytics
- Compliance/reporting
- Storing historical data
- Equipment management

Objectives/Requirements -

- Create an interface that will pull and push information from the hospital's input medium to the dashboard.
- Create a dashboard which displays all the necessary information and tracks the appropriate variables. I.e. room and patient information, turnaround status, etc.
- Real-time data transfer capabilities; able to accept live data from the hospitals chosen medium and push it straight to Tableau.
- Real-time display; the dashboard, built in Tableau, will update and display the insights in real time.

Appendix 2: Evaluation Metrics

As discussed in the body of the paper, the tool was evaluated on whether it could accomplish the desired result. This means the interface has to push information on a real time basis, and the dashboard must reflect it. The hospital was very clear that the tool would only work for their

purposes if it displayed in real time. Given this strict criteria, our method for evaluating was on a pass or fail basis. As mentioned prior, both the interface and dashboard were able to meet these requirements once we took into account the hospital's infrastructure.

Appendix 3: Final Dashboard Primary Views

Displayed below are the primary views of the dashboard built in Tableau. The dashboard features several views such as the map view which pictures the whole OR department with colored rooms indicating their status, an individual room view which shows dedicated figures for the room selected, and an analytics tab which displays summary statistics and graphs. The analytics tab gives insights for the entire OR but displays metrics per room.

Figure 7. Partial Map View of Final Dashboard

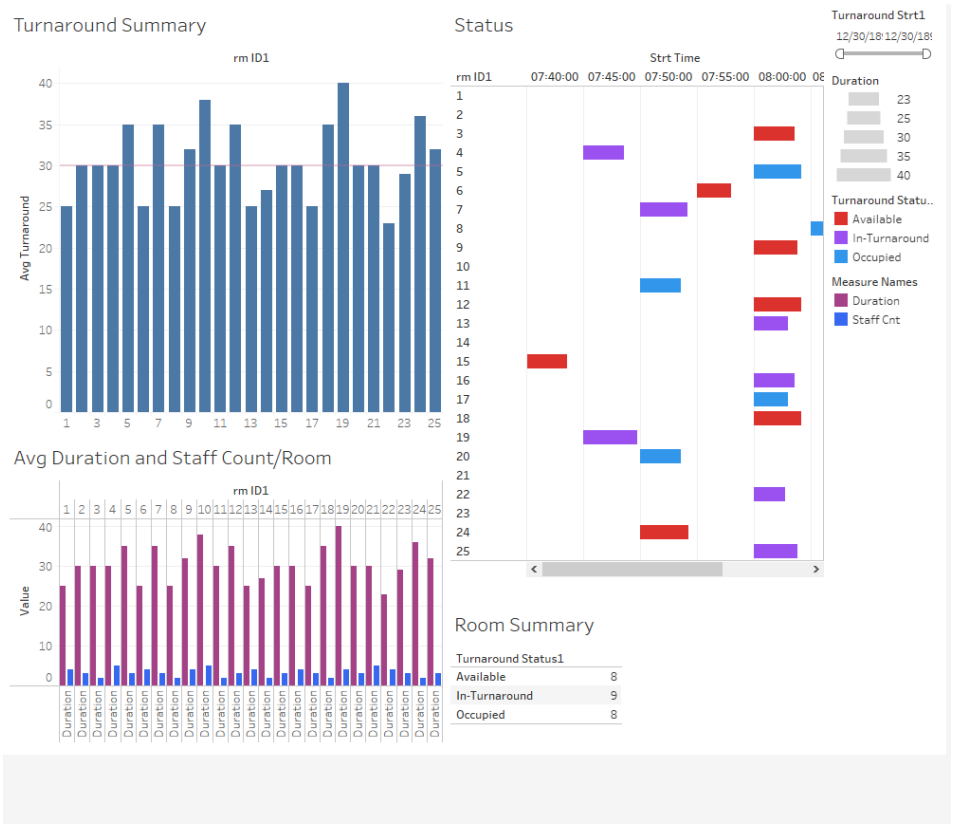


Figure 8. Analytics Tab View of Final Dashboard

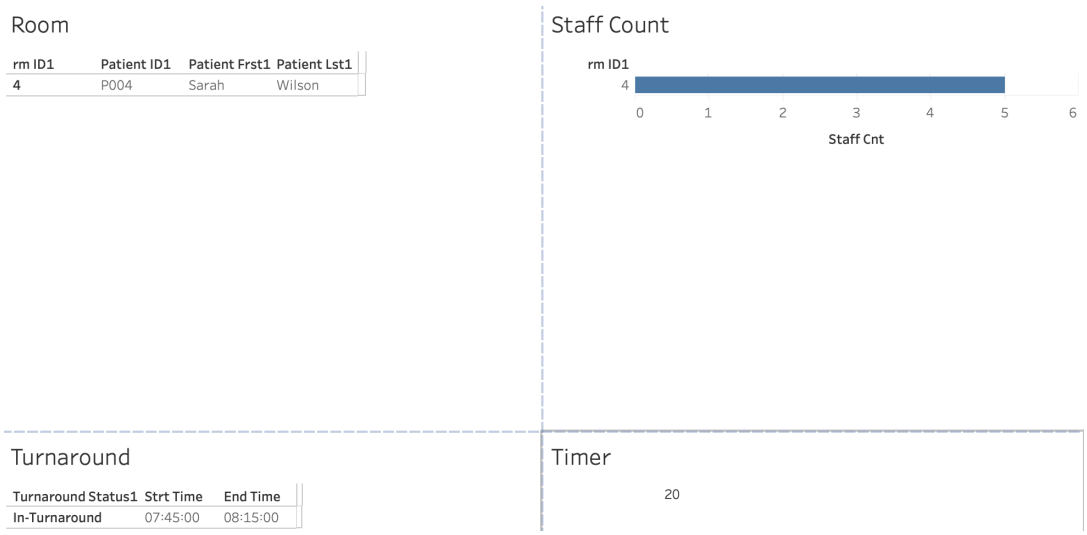


Figure 9. Individual Room View of Final Dashboard

Appendix 4: Risk Evaluation

Below is a table containing certain risks/concerns that arose either from the sponsor or our side during development.

Risk	Description	Mitigation Strategy
Turnaround Staff	The concern is that hospital staff, specifically the turnaround team, will feel rushed by the dashboard and the quality of work will suffer.	The turnaround timer implemented now counts up instead of down.
Data Security	The current interface does not have securities implemented. This is a major cybersecurity concern as some data the hospital includes will be privileged.	We recommended that the hospital build out the interface and include securities according to their specifications.
Data Validation	At the moment there is no mechanism to track discrepancies in data if there are any.	The interface was designed to house large loads of data at a time. We still recommended that the hospital implement validation in the interface.
Real-time Capabilities	The staff handling the operating rooms currently do not have the ability to access live data, as information has to be processed at their data warehouse and then is sent back the following day.	We have implemented data transfer functionality through a hosted server/client that is able to directly pass scanned information into Tableau.

Appendix 5: Individual Work Contributions

Joshua Kennedy:

My primary role in ensuring the success of this project was to focus on creating the dashboard as well as maintaining soft skills by being the team's communication lead. Our sponsors at the hospital stressed the want to create an interactive dashboard built off of the floor plan view of the OR floor. My main tasks and responsibilities originally consisted of rounding out sponsor needs and turning those into deliverables that the team could then create, after these were made my attention then shifted to Tableau where the dashboard construction began.

Before our final version presented at the showcase was constructed, a beta version was needed as a deliverable earlier in the spring. This beta version was used primarily to test all the features that our sponsors requested, and to make sure that it fell within our skill space. When

making this I felt constructing this beta on the whole floor map could deem a waste of time - especially if any issues were encountered. Due to this I decided to cut out a corner of the full map and use this as our “test OR floor”, which consisted of seven rooms that could all be tested using different dummy data. I created a preloaded CSV file of data that could display different status’, times, and patients. This CSV was then used to help create an idea of what data would be needed to populate the dashboard to become a final product. One of the most important lessons I learned through this phase was how to create the map itself. The traditional floor plan was a PNG provided by our sponsors at LRH, but the individual colored squares (“rooms”) were created by taking X/Y coordinates, plotting them on a separate sheet, and overlaying that on top the PNG map. This step was critical in the success of the dashboard, and required some research to figure out this non-conventional solution. Additionally calculated fields and filter actions were needed to allow for a seamless interaction flow when clicking different fields on the dashboard. This also ensured that correct data was shown for the corresponding room clicked.

Working in unison with Amanda, we created the final product and the dashboard used in the showcase. She was able to construct many of the pages and architecture needed, and took many of the functionality features from the beta and transitioned it over to the two dashboards. I assisted in adding the interactiveness of the map to the dashboard by transitioning the grid from our beta and blowing it up to the full scale final product. I also worked with Kenneth and Kaleb to connect these dashboards to the realtime database they worked on - and worked out any kinks while also using the realtime feature to build a functional timer within the dashboard. The timer is a specific feature our sponsors requested and I built it by calculating the minutes passed from a designated timestamp field within the data. This timer would change as people scanned in/out and could be seen on our showcase model as well as the final product received by the hospital. All of these efforts combined for a successful showcase demonstration as well as a finalized, polished product to be deliver to LRH in the coming days.

Amanda Rodriguez:

Participating in the capstone project to develop a real-time Operating Room turnaround dashboard was a significant milestone in both my academic and professional career. Our team is made up of three majors, making it an interdisciplinary team. We were able to collaborate closely to design and build a solution that addressed all customer needs and concerns. My primary responsibility centered on creating the Tableau dashboard and all supporting data/documentation that went along with the deliverable. The dashboard serves as the core visual and analytical tool the hospital plans to use.

The goal of the project was to provide hospital administrators, OR controllers, and other OR staff with a real-time view of OR usage, turnaround times, and patient information. The hope is that this tool will help to reduce delays and improve scheduling by having a more transparent view into the turnaround process. I played an integral role in developing and completing both the final version and demo. This involved creating the dummy database, for which I built a relational schema in MySQL, based on my research into the hospital's specific data needs. I then extracted the data

into csv format. There were two separate dummy datasets one with more data for the final dashboard and a simplified version created for the demo. I researched and built data flows in Tableau to perform multiple automated functions. One flow was similar to an ETL process, which would prep the data for analytics. Due to time constraints with the showcase, I decided to take the simpler approach and just use built in calculations/functions. Given that the data updates regardless, this flow was not necessary, but it sounds cool, duh. The other flow, which was also not implemented as it was not likely it would be used, was a time series flow. The hospital has not shown particular interest in holding onto historical data for analysis purposes. But in the supporting user guide, this flow was explained and recommended. So hopefully there will be a use for it.

For both the demo and final dashboard, I was required to design the architecture and tabs. To accomplish this, I had to relearn a lot of Tableau design. I utilized calculated fields, filters, and dashboard actions to create a functional dashboard. Essentially, the filters and actions allow for the user to click on any room in the map view and take them directly to the room view for that room. The room view contains important turnaround, staff, and patient information. This makes it easy for the user to navigate through views and makes the tableau file itself smaller in size/less computationally expensive for the device (by eliminating the need to create a room view for every room, now we only need one). The calculated fields were used to create the graphs and figures for the analytics tab. These work by allowing a user to create new data from pre-existing data similar to using “def” in python to define functions. My functions performed tasks such as calculating start time in minutes from zero, time/duration a room is active, finding average turnaround times for each room/operation, and calculating room utilization. Using these fields, I created the analytics tab which showcased average turnaround per room, a gantt chart demonstrating room utilization, average duration of operations per each room, and a summary of each of the rooms status. These graphs/figures can be toggled using a built in filter. Making it so that the user can see how the data changes over time and even see the data for specific windows (daily, hourly).

Finally, I created and organized the Github repository, which is the medium through which the team is going to submit the project to the sponsor. I populated the dashboard section with the dummy dataset used, the Tableau workbook, and a user guide I created. This user guide is an 8 page document meant to help the IT team or any semi-technical to technical staff member to integrate this dashboard with their data. It explains why we use a dummy dataset and how each of the filters, calculated fields, and actions works. With the guide, the hospital should have all they need to use the dashboard and get their desired results

Renato Silva e Silva:

Majella Scheyhing:

Throughout the project, I played an influential role within the team to complete our final deliverable of a dashboard to help Lakeland Regional Health achieve their goal of a thirty-minute turnaround time for 80% of cases handled in their OR.

At the ideation phase of our project, I proposed the concept of utilizing a Real Time Locating System with the use of Radio Frequency Identification technology to meet the customer's need for real-time data collection. Although we did not end up implementing this technology, I conducted hours of research on this technology utilized in different industries, including healthcare. This helped me determine that infrared RTLS would be the best to implement because it doesn't pass through walls, ensuring accurate room-level location. This is essential with our proof of concept model, which has our data input, whether it be scanners or an RTLS Sensor located in the doorframe for touch-free data accumulation.

Our physical model is what I am most proud of. During a meeting with one of our sponsors, one of them proposed the idea of taking Barbies and a doll house to demonstrate patient tracking. While this would be a very colorful and unique visual, I was confident we could come up with something better. I led the initiative to build the model as I had experience in drafting and modeling from high school. I generated the initial floor layout and gathered and decided on the best materials to use for the model. Once the design was scaled and the materials were collected, I carefully measured and cut all of the pieces we needed out of cardboard and balsa wood. After I finished all of the technical cuts and measurements, my teammate painted and glued the pieces together. I then researched 3D printable figures online until I found one that was perfect for our model.

Collaboration was essential to my role on this team, as once the model was constructed, I worked closely with Kaleb and Kenneth to take our demo from concept to reality. We worked to create patient-specific information for the figures of the model and align in-room statistics for the specific rooms on the model. From here, I was able to create QR codes for the In and Out of room data inputs in addition to the patient-specific information (John and Sarah), which were created by my teammates. I was honored to co-lead the majority of our presentations and found it very rewarding and exciting to demonstrate our demo and show off all of our hard work to our sponsors, faculty, and peers.

Kenneth Pierce:

I started this project by building the full server-side system from the ground up. Using Python and Flask, I created an API that served real-time healthcare data and could run continuously while handling live updates. I made sure the server could be accessed remotely, added timestamping to every change, and designed it to support simultaneous command-line interaction.

This allowed me to simulate real operating room scenarios, where staff and patient data could change moment to moment and the system would reflect those changes instantly and reliably.

One of my main goals from the start was to build a real-time data transfer interface that could update every few seconds inside Tableau. To do that, I built and connected a Web Data Connector (WDC) that pulled from the server's API and displayed the data visually. I spent a lot of time testing the system between different machines including Windows and macOS and working through issues like firewalls, port access, and CORS configuration to get everything talking to each other. I also added in the ability to simulate RFID sensors or API-triggered updates using terminal commands, which makes this system flexible enough to plug into more advanced hardware or secure environments down the line.

Along the way, I also learned a lot about healthcare data standards like HL7 and FHIR. These shaped how I thought about structuring the JSON data and reinforced the importance of clean, consistent, and interoperable formats especially when working with sensitive or critical information. Overall, this project helped me grow both technically and conceptually. It gave me experience with live systems, secure data handling, and dashboard-driven insights all while building something that could genuinely be useful in a healthcare setting.

Kaleb Walden:

My goal for the project was to implement a way to have data be parsable within Tableau. I put my efforts into a public general API called Swagger IO, which would have allowed me to query data from an online database that I could then parse into Tableau. The reason for this was for it having the ability of replicating functionalities that FHIR is able to accomplish in a healthcare setting. Since FHIR required onboarding by both the healthcare facility (Lakeland Regional Health) and Cerner whilst costing money to do this alongside, the public general API seemed viable. Working with this, I was able to get data sent into Tableau that was able to display. However, issues with it included manual information input as well as the information parsed into Tableau being unusable in any created dashboard. Ultimately, this focus had to be scrapped.

After this implementation ended up not being feasible, Kenneth and I spent time working on implementing a data-transfer system that was hosted directly in our local machine. With this, we were able to utilize the server ip/port on one of our local machines that we were then able to host our own domain that can parse data into Tableau. Through this as well, the data passed into Tableau is able to be used within created dashboards through a web data connector that directly connects to the domain we are hosting. This also works for real-time capabilities that do display. With the server, we have a file with writable data that can be edited through terminal commands. Focusing on scannable information, we are able to use a scanner on QR codes that have commands within them. These commands feed changes to the server that updates the file and then directly sends that updated file to Tableau through the connection set by the web data connector. With this, we were

able to accomplish a proof of concept in showing a real-time data transfer to Tableau that the hospital in the future could work towards implementing through their facility that they currently do not have.